A Historical Perspective on Evolutions and Revolutions in Small Arms

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The initial round of the Small Arms Seminar Series was convened at the United States Military Academy at West Point from September 11-13, 2012. The first gathering drew together a combination of technological consultants, subject matter experts, US Army officers, historians, and other interested parties to set the boundaries that would be in play in the future explorations in the long term development of small arms. The heart of the discussion was the examination of historical processes which had resulted in large-scale changes to the military art, discussions of the history of science, and several case studies of recent issues involving doctrine and development that might offer clues to the central tensions of the seminar. Specifically the seminar was seeking to define three areas of understanding: what is a revolution in small arms as opposed to an evolution?; what systemic factors must be considered in the pursuit of a revolution?; and finally, given such a definition and variables, is it feasible to pursue such a revolution? In the opinion of the Department of History Subject Matter Experts, evolutions and revolutions can be defined and located in the historical record; however these alterations in small arms must be understood within their historical contexts and the current system of small arms production and funding make producing a revolution difficult, maintaining it more so, and predicting it almost impossible.

Defining Evolutions and Revolutions

Given the parameters of the task, the initial difficulty was understanding what could be considered a revolution and what was merely an evolution within the context of military technology, broadly, and small arms in particular. Once located, the definitions would provide a framework to

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14. ABSTRACT

The initial round of the Small Arms Seminar Series was convened at the United States Military Academy at West Point from September 11-13, 2012. The first gathering drew together a combination of technological consultants, subject matter experts, US Army officers, historians, and other interested parties to set the boundaries that would be in play in the future explorations in the long term development of small arms. The heart of the discussion was the examination of historical processes which had resulted in large-scale changes to the military art, discussions of the history of science, and several case studies of recent issues involving doctrine and development that might offer clues to the central tensions of the seminar. Specifically the seminar was seeking to define three areas of understanding: what is a revolution in small arms as opposed to an evolution?; what systemic factors must be considered in the pursuit of a revolution?; and finally, given such a definition and variables, is it feasible to pursue such a revolution? This report answers these questions and summarizes the results of the seminar.

15. SUBJECT TERMS

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understand the ultimate goal of the seminars as well as direct the discussion towards the process of producing revolutions in the technology. In addition, the definition would essentially determine the possibility, if any, of predicting such decisive changes within the field of small arms.

To begin with, there was the necessity of understanding evolutions within military technology. There are several traits which may be ascribed to technological evolutions and these would prove useful in circumnavigating the greater concept of revolution. In fact, the existence of some traits would serve as a marker that it was indeed an evolution and not a revolution. First of all, an evolution was simply a refinement of a previously existing technology without substantially changing the usage of that technology. In a related manner, evolutions and their effect are immediately comprehended due to their limited overall effect. Finally, evolutions can occur without creating a decisive gap in technology between its owner and those without and as such do not compel the adoption of them by have-nots.

Historical examples of evolutions are legion. The progress from matchlock firearms to flintlock and then finally to percussion caps were each an immediately evident and substantial improvement on the firing mechanisms of smoothbore muskets. However, the qualitative difference did not create a decisive gap between adopters and non-adopters and while each in turn was adopted, the pace of adoption was leisurely and as late as the mid 19th century Baluchi mercenaries were still using matchlocks with great effect against more modernly armed troops.[1] The same process can be found with the improvement of technique in fabricating gunpowder, the necessary propellant for the rapidly improving firearms. While better powder was always preferable, the actual qualitative difference during the Napoleonic Wars between powers with excellent powder (Britain) versus those with a worse product (France) was hardly noticeable. The slightly shorter range and quicker fouling of the French muskets in the end were not decisive differences nor forced a mad scramble for the French to improve their production. Finally, even the process of creating magazine-fed rifles, while increasing

[1] A roughly contemporary example would also be the flintlock, smoothbore jezails of the Afghanis proving extremely effective against the percussion-cap rifles of the Indian Army during the 1841-1842 invasion and retreat from Afghanistan.

the capacity of the firearm by five or more rounds, did not have a necessarily decisive alteration. African soldiers using single-shot Model 1871 Mauser rifles[2] did not necessarily suffer a decisive gap against magazine-rifle armed British troops throughout the East African campaign of the First World War. In each case, improvements had been made in the technology status quo that made it qualitatively better in an understandable, linear progression. The firing mechanism had been made less cumbersome and more reliable; the powder had been made cleaner and more effective; the rifle had progressed from a single-shot to multiple before requiring reloading; each step was understandable and yet caused little quantitative difference. This is of course not to say that taken as a whole and with enough acting in concert that evolutions cannot have profound effects; the smoothbore matchlock musket was a far less deadly beast than a percussion-cap rifle. However, none of the small changes ended up creating what might be thought of as a revolution nor created a period of "dominance" for its owner.

Revolutions on the other hand are a far more exciting and yet elusive concept. Revolutions are what may be termed "disruptive," upsetting the status quo or accepted paradigm. They are often rejected at first due to their challenging of existing doctrine or dogma. Their adoption is transformative and most often overturns the accepted conception of the role of the technology itself and its possibilities for the future. Finally, revolutions within the concept of military technology, once adopted, offer an immediate decisive advantage to their user, which in turn compels the have-nots to adopt these technologies or face an asymmetry of force that is insurmountable. To put it concisely, revolutions in small arms are often unforeseen and transformative not only for their developers, but for all parties that engage them. They change the paradigm of combat.

Historical examples of revolutions in small arms are far harder to determine. Perhaps one of the few prime examples that exists is the cased cartridge. The revolution of having projectile, propellant, and ignition system within a single, self-contained round had numerous and far-reaching effects. The rounds themselves became more consistent, more reliable, resistant to weather and extreme conditions,

[2] Note that these rifles were also still using black powder cartridges!

and overall safer to handle. Above and beyond this, the enabling effects of the self-contained rounds pushed other evolutions forward; with the advent of such cartridges innovations such as breech-loading mechanisms, lever-action loading, bolt-action loading, magazine rifles, and even automatic fire became not only possible but actually plausible. The last of these, automatic fire, also has an argument towards being a revolution; the ability of early automatic weapons like the Maxim gun to put a significant amount of lead in the air significantly altered the tactical and strategic outlooks for both its early adopters and victims.

Historical revolutions in military technology writ large are of course easier to identify. One may look at any number of war-making machines since the industrial age and understand how they altered the strategic and tactical paradigms of their time. Military aviation remains one of the few revolutions that were seen coming; however following the adoption of warplanes, all possible adversaries now needed to take air power into consideration and adopt their own air forces. One can make the same arguments with tanks, to a degree. Once armored warfare was adopted (in this case meaning not just the machine but the doctrine to match), the entire strategic context for industrial age armies changed. Of course it is of interest in both of these cases, the appearance and the discovery of the doctrine for the machine was revolutionary in the meaning we have adopted. They altered the very understanding of the way wars were fought. However, following this radical change, very little that has developed might be termed “revolutionary” in their field. Much like firearms, following its original transformative moment, each iteration has produced several evolutions in the concept, but very little chance of a revolution. The tanks of today provide the same role as their early models, but achieve it with more firepower, more mobility, and more protection than their forbears. The same may be said of warplanes; while they are undoubtedly faster and more lethal than the prop fighters of the World Wars, they are not a revolutionary step by any means. This then, might offer a slight insight that will be covered in the final section.

Systemic Factors

Although working definitions are a prerequisite, the search for a revolution also requires a thorough understanding of the context in which a revolution would occur. A revolution does not exist within a vacuum; it does not simply appear and immediately become evident and useful to the creator. Military technology, revolutionary or not, exists within a complex system that incorporates cultural, social, economic, material, and political strictures into every stage of its development, deployment, and use and all of these ultimately have a role in determining the ultimate understanding of a military technology.

In terms of cultural factors, these include moral or ethical ideas about how and why war should be waged. These in turn direct what avenues of exploration we take for future developments as well as the value we place upon characteristics of weaponry we develop. An early historical example is the use of soft lead 'dum-dum' bullets which mushroomed upon impact, causing horrific wounds. Due to their destructive capacity and the increasing care towards human life, these rounds were proscribed following the Hague meetings in 1899.[3] For a more contemporary concept of cultural forces that shape the development of arms, one may look towards the development of precision munitions and the cultural path from minimization of friendly casualties to the minimization of all casualties that are not enemy combatants.

In its early years, the United States largely escaped the seemingly endless series of long, bloody wars in eighteenth and early nineteenth century Europe. The American Civil War changed this; the vast number of casualties resulting from the battles of Shiloh, Antietam, Gettysburg, and Cold Harbor shocked the nation. American attitudes were exacerbated by the nightmarish experiences on the Western Front during the First World War. While America's relatively brief experience in trench

[3] Complicating the cultural ideas of these 'humanitarian' objections, the British originally defended their usage of dum-dums by noting their efficacy against colonial populations and lobbied to be able to continue using them against such targets, thus implicitly drawing a boundary around what peoples could even be considered in these considerations.

warfare meant it did not develop the widespread revulsion common to other Western European nations, aversion to excessive casualties was a driving factor in American strategy during World War II. Initial proposals for American strategy included an army of more than two hundred divisions, along with a massive naval and air force. Ultimately, though, resource limitations and political preference drove the United States to emphasize its industrial and technological strengths.[4] Firepower would replace manpower; the 200-division force was cut to a mere 90, while the naval and air forces grew to unprecedented levels. True, the outstanding performance and great sacrifice of American ground forces played a critical role in the defeat of Nazi Germany, but many observers argued that American air power and naval power had proved far more decisive in the outcome.

The stunning conclusion of the war in the Pacific seemingly reinforced these lessons. The twin atomic bombings of Hiroshima and Nagasaki seemed to indicate that the new nuclear capabilities of air power would render "conventional" naval and ground combat useless. At the same time as America's martial ardor cooled after the Second World War, the recognition of the havoc wreaked upon German and Japanese cities in supposedly "precision" strategic bombing campaigns caused many to question the morality of bombing, atomic or otherwise. The popular reaction to the "limited" wars in Korea and Vietnam only hardened these views on the devastating side effects of air power, while even more dramatically reinforcing Americans' aversion to casualties.

In response, American military forces increasingly looked to new technological developments in the field of precision guided munitions, which would provide the firepower necessary to spare American lives, while also reducing the dreaded "collateral damage" of killing civilians. These efforts bore fruit by the 1991 Gulf War, when military and civilian opinion alike watched in awe as "smart" bombs annihilated enemy targets while (seemingly) minimizing collateral damage. This trend towards precision weapons has only accelerated in the conflicts of the last decade. The increasing search for

[4] Note the interplay between cultural preference (lower casualties), economic pressures, and political shaping that drove military technology research.

‘humanitarian’ solutions to war and the cognizance of its moral dimensions have shaped and continue to shape the development of arms.

Social, economic, and material constraints have shaped the evolution of small arms since they existed. Perhaps a central example of all three of these would be the Spencer Repeating Rifle, a lever-action rifle using metallic cartridges developed and used by the Union during the American Civil War. During the war, Union Brigadier General John T. Wilder created a particularly potent Infantry Brigade. Learning lessons from experiences earlier in the war, Wilder outfitted his troops with Spencer Repeating Rifles. Following the Battle of Murfreesboro in early 1863, the Union and Confederate lines in central Tennessee remained static for months with Bragg’s Army protected by the mountains of the Cumberland plateau. The only practical way for the Union Army to breach Bragg’s lines was through the five passes in the mountain range which the Confederates had heavily guarded. In June of 1863, Rosecrans began moving the Army of the Cumberland south to attempt to dislodge Bragg’s Army of Tennessee from their mountain defenses. In the vanguard marching against Hoover’s Gap was Wilder’s Brigade. As the Federal Brigade approached the Confederate Cavalry skirmishers, the firepower advantage accorded by the 7-shot Spencer Repeating Rifle against the single-shot Confederate Enfield Rifle quickly dislodged the Rebel defenders. As the Confederates began to retreat, Wilder’s mobility advantage quickly turned the retreat into a rout as Wilder’s better fed and rested mounts outpaced the tired Southern Cavalry. Unable to provide early warning, the Confederate defenders quickly fled or were captured, and Bragg’s entire Army was turned out of position and forced to withdraw 100 miles south to Chattanooga.

Despite the essentially dominant effect of the repeating rifles in an era of single-shot, muzzle-loading percussion cap rifles, the Spencer Rifle was not adopted in any great numbers by either the Confederacy or the Union. For the Confederacy, although they had knowledge of the technology, they were essentially an agrarian society and they lacked the industrial base to even make such weapons in a large quantity. For the Union, although they had the technology and industrial society to produce the

weapons in a sufficient quantity, the economic and material base could not support the demand for the ammunition involved. While the Spencer Rifle could be made in most armories, its specialized cartridges could not be made in large enough quantities for general issue. As such, a rifle design that had the possibility of shifting the infantry paradigm of the time wasn't present in enough quantities to truly affect change. By the time such cartridges could be made in sufficient numbers, the army had already passed by the Spencer Rifle and adopted a different breech-loading weapon along the evolutionary path.[5]

Finally, there are several political and structural issues that shape or even prohibit certain paths for explorations amongst small arms. Depending on whether the weapons development is public or private can change the methods of exploration or even the emphasis placed on what aspects to concentrate. The branch of the military that the weapon is being developed for can alter the goals of the evolution or revolution. Politically influential individuals can be wedded to certain military concepts that create or block off paths of innovation. Finally, unrelated political ideologies can still have a large effect on what entities (public or private) can be involved in the experimentations, which alter the process of development as well. Perhaps the perfect example of this is the AR series of weapons that eventually culminated in the M-16.

In 1956 the Soviet's Kalashnikov line of weapons was revealed to the West during the Occupation of Hungary. Despite the appearance of a mid-sized round fired from an automatic weapon, two political fronts kept the United States from formally developing their own "assault rifles": the doctrine that the United States Infantryman fired a single, high-caliber bullet from a great distance and the epistemically closed system of US armories responsible for the creation of new arms. As such, instead of the American arms industry developing its own mid-power automatic rifle, it created the M-14 series of semi-automatic, full-charge rifles. However, with the United States' entry into the Vietnam conflict, where the US Infantryman now engaged an opponent armed with the Kalashnikov, the

[5] The 1973 Rolling Block Springfield

inapplicability of the weapon was shown. As such, significant alterations to the context had to be explored. In terms of doctrine, the United States military had to accept that in the context of a land war in tropical forests, their original doctrine no longer had the same effectiveness as it had in the open battlefields of Europe and Korea. While this took time, it was a logical progression.

However, overcoming the structural difficulties presented by the armories took a continued shift towards commercial weapons production in the latter half of the 20th Century. While the manufacture of weaponry by private firms is nothing new, it had always coexisted with widespread government manufacturing, such as the US Navy's shipyards in places like Boston, and the US Army's arsenals in Springfield and Harpers Ferry, which all dated to the earliest days of the Republic. After playing a critical role in weapons innovation and production – one example being the highly effective M-1 Garand rifle of World War II – these institutions came under increasing attack with the onset of the Cold War. Many Americans viewed government-run businesses as "un-American" and even socialist, and policymakers scaled back much of the government-run manufacturing of military gear. As such, by the 1960s private firms such as Armalite could finally penetrate the American military's weapons market to the extent needed to propose their new designs. This shift in production culture, from public to private, allowed the adoption of the M-16 rifle for use by the United States Armed Forces.

From Concept to Completion

Having now only glanced briefly at the plethora of complications involved in the concept of evolutions and sometimes revolutions in small arms, the question remains: can then, revolutions be sought and if so, can they be predicted and taken advantage of to offer a decisive asymmetry for their predictors? This may be accomplished by looking at the overall process of progress (within historical and present contexts) and in what ways evolutions have differed from revolutions. Then we might look at those processes and assess whether it would at all be possible to predict a revolution based on the

process by which it is sought.[6]

When technology is the driving cause behind changes in warfare, it generally follows one of two paths. The first is directed development. An army has a doctrinal need that must be fulfilled to meet some crisis.[7] The development of the tank is a clear example of this methodology. The trenches and machineguns of First World War battlefields had rendered the conventional infantry assault impracticable under most conditions. Furthermore, due to the Germans resting in entrenched positions upon prime French industrial and farmlands, the burden of the offense lay with the Entente forces. However, the battles of the Somme and Verdun had demonstrated that infantry, even when supported by massed artillery fire, could not survive in no-man's-land. This need drove a frenzy of experimentation that eventually resulted in the first tanks. These ungainly machines were slow and mechanically unreliable, but were able to fill the needs of the Entente forces. However, tanks did not fundamentally change British doctrine. Rather, they were incorporated into existing doctrine (with obvious adjustments for the new weapon), as these vehicles enabled the British to execute established procedures. What the first tanks did accomplish was a change in army organization, as they became integrated as an enabling infantry support platform.

The inherent problem with directed development is that once the initial needs statement is met, there is often little reason for an army to further develop either the technology or the doctrine with which it is associated. This intellectual stasis is plainly evident in the doctrinal manuals of the French, British, and American forces in the 1920s. However, occasionally, a creative mind will come upon a new use of an existing technology or relatively new technology that completely changes doctrine and organization. This is adaptive development.

In adaptive development, an innovator will modify a piece of technology to either fill an

[6] Albeit accepting that there are multiple variables that we cannot quantify nor perhaps even compare with the present existent ones.

[7] In this case, it may be viewed as being "too close to the customer," as noted by COL Shoop, where the established regime knows what it wants and therefore stifles greater innovation.

existing need, or to create something entirely new.[8] A significant example of this form of development is the creation of the powered military aircraft. The airplane had not originally been invented for military use. However, very shortly after its invention, creative minds saw the advantages offered by military flight. The first aircraft were unarmed reconnaissance planes, but the need to prevent enemy aerial scouting quickly led to the development of armed aircraft, and finally, purpose-built fighters. The introduction of the military aircraft would change not only organization, but doctrine as well

Returning to our previous example, during the interwar era, several innovators saw beyond the original limited use of the tank, and theorized that this weapon could accomplish more with minor modifications. However, most military establishments were content to continue using their armored forces in the manner for which they had originally been designed.[9] The German Army, fresh from its defeat in the First World War had few preconceived notions about the use of armor and, in the process, changed the tempo and lethality of war forever. It took the shock of the German victories in Poland and France in 1940 to convince other nations of the need to reform their own doctrine and organization.[10] This led the tank from being essentially a support to infantry (an evolution on the battlefield), to changing the method of fighting wars on several levels (thus being a revolution.)

These issues of change and the difficulty of creating a revolution with even previously existing technology dovetail with the issues involved in the present day field of weapons development. Given the dominance of the private sector in weapons manufacture, future trends in small arms development will have to factor in profit motivation in any development. If a weapons innovation, no matter how groundbreaking, is not sufficiently profitable, it will have great difficulty gaining widespread implementation. The global economy could also bear on profit-motivated innovation; compatibility with the systems and doctrine of other nations can only boost the potential for profits and further

[8] As noted by COL Shoop and the explorations of his cadets in terms of commercially available electronics.
[9] This intersection of Doctrinal stasis stunting technological innovation can also be seen in MAJ Earhart's presentation, where Cold War era doctrine effectively halted certain avenues of exploration due to the current small arms design fitting the parameters that had been decided upon by the war we thought we were going to fight.
[10] The travails of this particular evolution are far too detailed for a work of this scale.

encourage adoption. The nature of the profit-driven arms manufacturing and the global society will likely come into conflict with national security concerns, however. Any truly revolutionary (or even significant evolutionary) step may place businesses and armies in a conundrum. How to balance the massive profits a corporation would make with multi-national or even worldwide adoption of a new technology with concerns that sharing this new development will erase the home nation's potential tactical edge?

Finally, given the massive sums of capital and prestige that await even marginal successes to the alteration of the military battlefield, one must examine the incentive structure in terms of evolutions against revolutions. Trying to develop a revolution requires a military establishment willing to fund and accept literally hundreds of failures before coming across a winning design. On the other hand, given the entrenched interests and structures within a military culture, the "customer" already generally has an idea of what he wants and designs can be directed that way. However, this then leads generally to evolution as opposed to revolution; evolution is safe. Changes are predictable, programmed, and performance tested. Market research strives to ensure that customer always gets what they want. Needs statements are met with precisely what the needy can conceptualize. Nothing dramatic is changed, and society moves in a predictable path. Disruption is minimized by evolution, but this does not prevent some from aiming for dramatic, destabilizing developments. Militaries want to use technology to create revolutionary advantages and gain some form of overmatch, but their conservative nature prevents them from contemplating the radical changes that often are required to achieve true revolution. However, as noted, private firms cannot effectively offer that overmatch for a single customer, as this removes the profit base they require to truly fund large-scale innovative processes.